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May 30, 1941

AN ANALYSIS OF THE FOREST FIRE PROBLEM IN REGIONS I, II, III AND IV

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Introduction

Many details and some major features of the forest fire problem are recognized as distinctively different in various sections of the tremendous area embracing the Rocky Mountains from Canada to Mexico. The same rugged topography, covered with the same inflammable materials, exposed to the same variable weather, and the same causative agencies--lightning and man--exist, however, throughout this great expanse. Regardless of ownership, whether private, State, or Federal, the major problem is the same everywhere--to protect the destructible resources on wild lands so that these resources may forever contribute their utmost to the livelihood and welfare of human beings, communities,

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1/ As none of the forest experiment stations in Regions II, III, and IV has men specifically assigned to fire research, the fire problems of these regions were assigned to the writer and are intended to be included with those of Region I in the present analysis.

Appreciative acknowledgement is made to Regional Foresters E. W. Kelley, C. N. Woods, Allen S. Peck, and Frank C. W. Pooler; and to their Fire Chiefs or Assistants Axel Lindh, Clayton Crocker, Ralph Hand, A. A. Brown, and Alva A. Simpson; and to Experiment Station Directors M. Bradner, Reed W. Bailey, Chas. A. Connaughton, Arthur Upson, and their assistants, for their real labor in reviewing and commenting on a "Trial Statement" of this Analysis submitted to them in October 1940 as a beginning of the present statement. It is hoped that the character of their comments and combined experience is reflected in the present statement without distortion in any case.

(Over)

industries, and our Nation. However, as 82 percent of the forest land within this area is inside the national forest boundaries the fire problem here is primarily and preponderantly a national forest problem.

The present analysis of the fire problem for this great area leads to the identification and specification of urgency of specific research projects, but it does not pretend to indicate where within the area each of these projects should be initiated. Determination of regional and local priorities is the second, not the first, step. The first is to examine the nature of the problem, identify its major components, and to segregate these into distinct categories. It is only with such a classification as a guide that individual projects can later be given sound priority as to local, regional, and national justification. It is only through the control of such a classification that research can be prosecuted most economically and usefully.

There are at least two attitudes toward an analysis of this kind. The first would merely list and classify those particular features of forest fire control now generally recognized as "pressing problems." It would distinguish clearly between fire control policies which determine certain practices, and the factual knowledge used by administrators in dictating policy. This first attitude would limit research, and this analysis, to the determination of factual knowledge and exclude it from the realms of policy or chosen practices. Guided by such an attitude this analysis would accept without question the present Forest Service policy of "Control by 10 a.m." and would then confine its efforts to the factual knowledge believed to be needed in order to execute that one policy satisfactorily. Obviously, this

would ignore three indisputable facts: (1) That the "10 a.m. policy" may not always be the guide of Forest Service practice; (2) that the 10 a.m. policy is not the present objective or practice by other agencies than the Forest Service; and (3) that the forest experiment stations have an obligation to investigate the forest problems of other agencies as well as those inherent in the national forests. If, in answer to this third point, it is contended that the problems of different classes of owners should be investigated separately, it is worth repeating that topography, fuels, weather, and causative agencies recognize no "ownership" boundary lines.

The alternate attitude toward an analysis of this kind gives distinct recognition to ownership objectives and policies of fire control but not in terms of individual or temporary preference. It recognizes that the forest fire problem is one of many crops and many communities. Protection of wild lands from fire is not for timber alone, for forage alone, or wildlife, recreation, or streamflow. A fire problem exists only because some or all of these resources are believed to have a value worth protecting. One indisputable feature of the "problem" is the fact that more money could be spent in their protection than the particular resources endangered are, or ever could be, worth, either to the local community, to adjacent communities, or to the Nation. The fire problem therefore primarily consists of these conditions and not upon temporary "ownership" or the objectives of the present owners. Those may change tomorrow.

If it appears from this statement that the writer of this analysis proposes to investigate the entire field of "Why and Whither Forestry", that is not the case. That danger is clearly appreciated. If, however,

this analysis leads to some direct questions concerning the justification, or even the intentions, of forestry it is only because Fire Control, even more than the Engineering, Lands, or Information and Educational Divisions of the Forest Service is an all-crop, all-purpose, service division. Its objective is not the protection of any one crop or forest use. Furthermore, fire control by private, State, or Federal organization IS FORCED by accident and under natural conditions to spend huge sums of money in its work and then is expected to justify those expenditures! This is one extenuating circumstance that distinguishes fire control from all other phases of forestry.

An analysis of the fire problem therefore should be permitted to raise essential questions concerning the justification of the forest values that are to be protected, and this may, at times, lead to posing the question "Why and Whither Forestry" or even "What IS Forestry"? If certain features of "The Fire Problem" can be traced that deep, it may be helpful at least by showing that some of the most urgently needed thought and work is not by fire control men, but by those who specify what fire control men shall do and how they shall be limited in doing it.

I. Scope or definition of the field embraced by this analysis

This analysis is limited to those phases of the forest fire problem common to the Rocky Mountain region from Canada to Mexico, bounded on the east by the Great Plains and on the west by the States of Washington, Oregon, and California. This is distinctly an area of wild or forest land. Soil cultivation, manufacturing, and even mining, are individually subordinate to forestry.

The social and economic boundaries of the project are more difficult to define, but as fire control is practiced for social and economic purposes a definition of the purpose of fire control should circumscribe this analysis in those fields. Two such definitions have been proposed in the past. (a) The so-called "Minimum Damage" objective proposed by Show and Kotok, and (b) the "Least Cost Plus Damage" proposal by Headley.[2/] The first of these states that the socio-economic objective of fire control is to hold damage "to a reasonable, accepted minimum," without reference to cost. The second proposes that the sum of the costs and damages, all necessarily expressed in dollars, be held to a mathematically determinable minimum.

The fallacy of the minimum damage objective obviously lies in the fact that under the present American system of Government, economics, and industry, there can be no "minimum damage" regardless of cost. Somewhere in the course of reducing damages a stage will be reached beyond which it will be better economics to stand the loss rather than increase the cost. The fallacy of the least-cost-plus-damage objective, and THE feature which has persistently prevented its acceptance and use is the fact that the so-called "intangible" forest values destructible by fire have not yet been rendered in terms of dollars. Hence it has been and still is impossible to add all the costs to all the damages and thereby determine whether or not least-cost-plus-damage has been attained.

To attempt to define the scope of this analysis in terms of the

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2/ Forest Fires in California 1911-20 by S. B. Show and E. I. Kotok. U. S. Dept. Agric. circ. 243, p. 3.

objective of fire control, it is obviously essential that the definition should include both cost and damage. But it must avoid, for the present at least, the requirement of evaluating all damages in dollars. This can be done by defining the objective of fire control as follows:

To attain adequate protection at least possible cost.

Such a definition admits all possible objectives of all forest land owners; it recognizes the absolutely essential features of cost; it avoids the impossible requirement that all damages be stated immediately in dollars; and, finally, this definition can be readily broken down into four distinct parts, each constituting an essentially separate step and objective. As will be evident in the following discussion, step D cannot be taken without first having taken steps A, B, and C. This analysis would be delusive if it did not consider and stress the essentiality of making progress, in anything, in a sound order or progression.

Under the above objective of fire control, adequate protection at least possible cost, there are four distinct and orderly steps to be taken:

A. Specification of what will be accepted as "adequate" protection.

B. Specification of how that can or might be attained.

C. Determination of the actual cost of providing that degree of protection.

D. Determination of how to reduce those costs as rapidly as possible to the "least possible" and still obtain adequate protection.

As is evident, objective A will vary with ownership. it may vary from place to place under a single ownership and it will undoubtedly vary with time and changing socio-economic conceptions. Specification

of the objective constitutes a definite and probably never-ending field of effort. It is a field which, because of neglect in the past, has certainly contributed to the creation of what we call the fire problem and has made it seem much more complex than it may really be.

The objective here requires, first of all, a decision whether a philosophy of plenty or a philosophy of scarcity, hence high prices, will guide our efforts. If adequate protection is to mean plentiful timber, grazing, recreation, wildlife, and water, any analysis of the Fire Problem will come out very differently from the conclusions that will be reached and the research projects that will be recommended under a philosophy of scarcity of timber, grazing, recreation, etc., such that each of these resources commands a high price due to its scarcity. As David Cushman Coyle has said in "Our Forests" we can more than double the money value of timber by burning half of that which is now available. This analysis of the Fire Problem would be baseless if it did not stress the need of choosing one of these two fundamental philosophies or a specific compromise between them.

Objective B, the specification of how adequate control might be attained, is an altogether distinct field of effort and one in which much work has already been done. That work has been MADE complex, however, because, while the effort was being devoted to specifying the methods of attaining adequate protection, no satisfactory definition of adequate protection was furnished to the workers! Actually past effort toward objective B has been controlled not at all by a sound definition of "adequacy" of protection. It has been determined almost entirely by "funds available." "Buy what you can with what money you've got"--a financial condition--has been the major guide to date for private,

State, and Federal forest lands. It is desirable to note that by this procedure financial conditions and financial policy instead of being suited to the fire problem have been made a part of it and have thereby definitely contributed to its present complexity.

Objective C, or the third part of the basic definition circumscribing the scope of this analysis, i.e., the determination of the cost of truly adequate protection, appears to be entirely a matter of bookkeeping and outside the field of research. It should be noted, however, that this bookkeeping, this third step, must be taken before step D is possible.

Objective D, reducing costs to "least possible," is the last logical objective, but it generally has been, to date, THE major and over-shadowing control of fire control. At the very least, it must be granted that COST or finances has more than "permeated" all past effort to provide adequate protection at minimum cost. No "analysis" of the fire problem could be worthy of being called an analysis if it ignored or attempted to avoid this feature. Separate recognition of what we do not know how to do from what we have not the funds to try to do is absolutely essential. Not until costs are known accurately will it ever be possible to proclaim that they have been reduced to the "least possible."

If it is the function of research to get needed knowledge, then it is the function of policy makers either to get the funds or to dictate specifically that available knowledge will not be used due to lack of funds. Lack of application of knowledge must be separated from and not charged to unavailability of knowledge. It would seem to be within the scope of this analysis to discover and identify such cases, if possible.

It is desirable to point out here one seldom recognized but very important fact. In farming, manufacturing, mining, and in war, in fact in any undertaking, maximum efficiency and success always depend upon a carefully planned sequence of steps or actions. Eliminate or refuse to take any one of those steps and the chain is broken; the product of careful planning and design is ruined. The results planned for will not be attained and all the effort spent in conceiving a more efficient process will be lost. Older, rule-of-thumb, and less efficient methods may then actually be more productive than the new and more intricate method.

This has been the case in Region One, and probably elsewhere, whenever the admittedly intricate process of striving for adequate fire control has been greatly weakened and sometimes ruined by deliberate or forced failure to take certain of the prescribed steps. When certain fire control positions are not manned, in accordance with the Fire Plan, the chain is broken, the new plan breaks down, and some other, older, and undoubtedly less efficient system may then become actually more effective. This is especially true of the old and new detection systems. Such cases should be clearly recognized as lack of application of knowledge and not lack of knowledge.

II. Pertinent social and economic data

For the great area included by this study it is impossible here to present any social or economic data justifying a certain intensity of fire control for all or for any particular part of the region. Furthermore, this "analysis" is not being made as a piece of propaganda for public distribution. This analysis is not an attempt to get more funds for the Forest Service, for Region One, or for the Northern Rocky Mountain

Station. For the readers to whom this analysis is addressed there is believed to be no need whatever for social, economic, or any other data to substantiate the existence of a fire problem. It is doubtful, in fact, if the "Public" needs any more of the conventional "data" and assertions so generously dished out during the past 20 years. The writer is convinced that the Public knows full well that there is a fire problem. The fact that the Public has not leaped into action and forced all forest protective agencies to accept millions of dollars for fire control is probably due to five things: (1) the American Public does not leap, it has to be led or forced; (2) the dry type of "data" we have distributed so monotonously and largely to ourselves; (3) lack of conviction by the Public that it would get its money's worth; (4) failure of forest protective agencies to "go after" adequate funds in the best ways and places; and (5) an inherent public aversion toward increased Federal or State expenditures of any kind.

Assembling more of the conventional statistics concerning number of fires, acres burned, etc., is not being done in this analysis. The intention here is to attempt to examine the character of the fire problem and discover if possible the types of social and economic data that will be needed in order to produce public action, and in order to determine whether adequate protection at least possible cost can be said to exist or not to exist on any area.

If it can be accepted that ALL forest conditions and products destructible by fire are at present or may be expected to become worth protection, then the elements of interest are: (1) commercial timber, (2) livestock forage, (3) berries, bees, Christmas trees, ferns, and such wild land products, (4) water and its downstream effects, (5) recreation,

and (6) wildlife. Effects of fire on the soil itself or on the weather, not reflected by any of these destructible elements, are excluded from this analysis. The forest products listed are believed to be those whose utilization directly affects the welfare of human beings, communities, industries, and our Nation. If so, the job is not only the determination of the effect of fire on these products but is also, and more basically, determination of the effect of altering the supply of these products. As D. C. Coyle says: By burning half of our present supply we might double the dollar value of what remains.

The basic, inescapable socio-economic data needed are, therefore, first the available quantity and rate of consumption of these products of the forest, and, second, the effect of altering the supply both in quality and quantity. For commercial timber, the national Forest Survey promises to provide the essential information. The present and future need for livestock forage and those miscellaneous products, berries, bees, and Christmas trees, also probably can be estimated with reasonable accuracy. The regional planning boards of the National Resources Committee undoubtedly can and should be expected eventually to specify the quantity and perhaps the quality of these products that are demanded nationally and where they should be produced locally. Protection needs for these elements can then be based on these specifications.

It is apparent, then, that the essential data for presently salable products are or will be provided and that additional research will not be needed. That is not so clearly the case for water, recreation, and wildlife. The effects of forests on streamflow, especially when these effects are made to include "downstream engineering values" as recommended by Show and Kotok, constitute a tremendous void not only in

our socio-economic but also in our biological knowledge. Work on the latter is, however, well organized and being prosecuted more and more vigorously by the Forest Service Research Division of Forest Influences. That division undoubtedly should be expected to furnish the necessary information concerning streamflow changes caused by altering any forest canopy. But the downstream effects on irrigation water supply, flood damage, and such social and economic conditions, whose measure is one index of the degree of forest protection needed in the headwaters, is another matter. Studies by the War Department may furnish some of this essential information but it seems obvious that a large amount of these data will have to be assembled specifically by investigators of the fire problem. Possibly the "Committee on Agricultural Policies for the West" can aid materially by assigning specific features for study by other agencies in the Department of Agriculture.

The same lack of existing knowledge and an even greater lack of coordinated work is evident in the fields of recreational and wildlife values destructible by fire. Progress is definitely hampered in these two fields by an ingrown and quite widely existent attitude that these elements of the fire problem are "intangible" and cannot be reduced to terms that will indicate the degree of protection from fire which each of these elements warrants. We are foolishly inconsistent, however, when, on the one hand, we insist that these intangibles cannot be evaluated, and on the other we aid and approve and attempt to use such resolutions as the following, which was passed by the American Camping Association at its Washington, D. C. meeting in February 1941:

> "We recognize wildlife as a major national forest resource having large social, economic, and aesthetic

values. Its protection and adequate management on more than 225,000,000 acres of land within national forest boundaries is an important responsibility which requires proportionate financial consideration with other resources in the management of forest properties."

THE ATTITUDE that wildlife and recreation cannot be evaluated is one of the major obstacles existing today in the path of progress toward "Adequate Fire Control at Minimum Cost." It is a defeatist attitude and deserves just one form of treatment--to be squashed by research which WILL find a way.

While more detail could and perhaps should be offered, it is hoped that the conditions described above warrant the following conclusions:

1. The most basic feature of "The Fire Problem" is the socio-economic specification of "adequate protection" in terms of the destructible values at stake.

2. No "analysis" or list of needed research projects could pretend to be complete if it concentrated on one or two of these destructible values and ignored the others.

3. Several different agencies are already engaged in work that will or should determine the value of some of these destructible elements. The works of those agencies should be coordinated, and redirected where necessary, so that a reasonably complete and sound justification for fire control expenditures may be established.

4. For those destructible elements not yet being investigated by any agency there is immediate need of research leading to specification of the public need and to determination of the effect of altering the present supply.

5. The Fire Problem, particularly the socio-economic phase of the fire problem, is not for solution by Fire Research alone. In fact, the fire problem on national forests is probably not for solution by the Forest Service alone, any more than the fire problem on private land can be appraised and finally solved by the largest individual owner. THE MAJOR NEED AND OPPORTUNITY is for a new, truly national concept followed by coordination of effort by many agencies.

6. The Forest Service undoubtedly has the legitimate function as well as the obligation to assemble evidence and to recommend what the public should accept as "Adequate protection at minimum cost." If this sounds like "Bureaucracy" and is to be avoided on that account, then the question must be answered, "Can The Public be expected to investigate and to specify what degree and cost of forest protection it desires?" The answer is obvious. Recommendations of what should be accepted as "adequate" and as "least-possible-cost" are definitely within the scope of this analysis and research resulting from it.

III. Problems presented

The one characteristic common to the six conclusions just stated is the approach or attitude toward the fire problem as a whole. "Approach" to any problem is believed to be vital. To find out how to do a thing well and then strive to reduce costs is believed to be the best approach to any problem not only because it is the more rapid in producing results but also because it should be more economical in the long run. THAT HAS NOT BEEN THE PAST APPROACH to the fire problem. The writer bases this assertion on 19 years of intimate experience in Region One and increasing familiarity and knowledge of conditions in other regions during this same period. He is prepared to cite cases throughout the services of

Howard Flint, Frank Jefferson, Theo. Shoemaker, and Axel Lindh as Fire Chiefs in Region One which substantiate this assertion. These, and many other cases from other regions, prove, if caseproof is necessary, that the past approach and attitude has consistently been one of "hold down expenses FIRST, then do a good job, if you can."

If it is believed necessary to assume that the Forest Service, the Park Service, or the Indian Service, for examples, cannot possibly get enough funds to find out how to provide adequate fire control then there is little use in defining "adequate" for any destructible element or for any of these owners. "Adequate" in such a case will be determined by available funds. It will be a shifting standard, now up, now down, scientifically baseless, and, to other sciences, scientists, and professions, and finally to the public, nothing but a weak "expedient."

If it is assumed as a starting point that funds will NOT be made available to determine <u>how</u> to do the job well, then the entire program of research must be based on not what is known to be needed, but rather on research and practices that are permitted by available or immediately expectable funds. Such a program would be contrary to the entire principle of Land Use Planning, Natural Resources Planning, and all of the many other similar moves by our Government started within the past 10 or 15 years. It is therefore rejected here as inconsistent and untenable. Until it is specifically rejected <u>nationally</u>, progress in fire control will continue to be definitely and seriously impeded.

This rejection may be poor "politics" because "the easy way," politically, may be to do what we can with what we've got, and simply ignore features of the problem that are "too complex" or "too difficult." The present analyst prefers, however, to attempt to analyze. He believes

that what we have been calling the "Fire Problem" is not entirely a matter of fire and that this fact must be fully appreciated if either the economic or the fire phases are to be examined intelligently, and dependable conclusions reached.

This matter of "approach or attitude" is therefore rated as Problem No. 1. It is believed to be even more basic within the Forest Service than the choice between a philosophy of plenty or a philosophy of scarcity. The recommendation is therefore made that the controlling attitude of all future fire research shall be: First to find out what seems right or best for adequate fire control almost regardless of cost of the practices. (This, probably, is all that Show and Kotok intended when they first advanced their theory of "minimum damage.") Secondly, the cost of providing what is deemed to be "adequate" will then be determined by actual application over a sufficient period of years to warrant conclusions. (Past emphasis on holding down costs FIRST has consistently prevented such determinations by the Forest Service while insufficient funds and facilities have done the same for the Park and Indian Services.) Third, until such determinations and tests have actually been made there can be no justifiable claim that the cost exceeds the benefits.

Problem No. 2 is, without doubt, the choice between (1) an abundance of all forest benefits, and (2) a predetermined scarcity. This choice is well stated at the bottom of page 138 of "Our Forests" by David Cushman Coyle. (Cost 25 cents per copy from the National Home Library Foundation, Washington, D. C.) Until this basic but debatable question is settled there is little point to any presentation of other fire research projects beyond a conventional list of those which seem possible with the funds now at hand. Such lists are included in all

experiment station annual reports for the last several years.

Problem No. 3 for this area of predominantly national forest land is believed to be: The delineation of the functions and responsibilities of Forest Service administration and research, respectively. This is a problem of more than regional scope because if the Fire Problem Analyses for the several regions and experiment stations are to be coordinated nationally the bases upon which future work is assigned, either to Research or to Administration, must be clearly and specifically stated. Assignment cannot be left to local decisions unless the standards are known upon which all of the decisions are based. While the standards might desirably be different, from one region to another and in the Washington Office, they certainly should be stated. Otherwise, of what will "coordination" consist?

No progress will be made by avoiding the fact that within the past few years while the Park Service, the Indian Service, and the State and private timber protective administrative organizations have come to depend more and more upon the Research Division of the Forest Service, the administrative branch of the Forest Service, particularly the Washington Office Division of Fire Control, has "branched out" into the field commonly called "research." The outstanding case is Dr. Shea's excellent work in fire prevention. Minor cases include chemicals for fire suppression, "bombing" fires, evaluating the "intangibles," and a "national scale of fire danger." While some of these projects have been cooperative, as they perhaps should be when they are half knowledge acquisition and half development of field practices, the most outstanding and costly project, fire prevention research, has been definitely and entirely financed and directed by administration.

It is not the intention here to argue whether or not these recent departures have been "right" or most efficient. It is obvious, however, that if a fire research program is to be prepared and certain phases or projects are to be assigned to research while others are assigned to administration, a definite policy must be stated as specifically as possible.

One policy is at present generally recognized by the Park Service, Indian Service, and State and private foresters. This is that these agencies can and should depend upon the forest experiment stations to work on their fire problems. This is true whether or not these problems are different from national forest problems. This policy has not yet been but it probably should be stated officially. It might beneficially include a statement whether or not and under what conditions these other agencies will be expected to contribute funds, quarters, subsistence, or equipment directly to research projects, and whether or not they will lend their support to Fire Research appropriation estimates. Increasing their own appropriations sufficiently to permit reallocation to fire research by the forest experiment stations is one method but it would not guarantee stability and continuity of research as well as adequate appropriations direct to Fire Research.

If it is true, as previously asserted, that the Fire Problem even on national forests will not be "solved" by the Forest Service alone, and if it can be presupposed that eventually some master planning agency will correlate and integrate the objectives of the Forest Service, the Park Service, the Indian Service, and all other Federal, State, and private forest protective organizations, then Problem No. 3 also embraces the delineation of these master responsibilities. At present the Park

Service has stated one of its objectives in fire control as "the most efficient fire control organization in the country." Possibly that is also the objective of the Forest Service. But somewhere in the course of this development some agency, Congress itself perhaps, may be expected to "take a hand" in this program. Within the Forest Service the past rivalry between regions for funds to improve local efficiency might develop to the stage in which the Division of Agricultural Economics may have legitimate functions and responsibilities. Perhaps California's water IS worth more than North Idaho's timber and perhaps the scenic greenery of national park trees is worth more than California's water. There is a definite problem here as to where Fire Research fits in and how far its program should attempt to go. The writer believes that considerable research (largely economic) will be required before this situation and problem can be even stated explicitly.

These three problems of (1) attitude, (2) sufficiency vs. scarcity, and (3) delineation of responsibility, are "presuppositions" in the sense pointed out by W. B. Pitkin that, "Minds never meet when their presuppositions differ widely." The writer contends, with all the emphasis at his command, that until these and all other essential presuppositions concerning "The Fire Problem" are recognized and agreed upon, minds cannot meet concerning many features and details of the Fire Research Program. Just as a large part of the granted complexity of the fire problem is believed to have been injected by an impedimentous financial policy, so it is also believed that other complexities have grown out of failure to state and agree upon other essential presuppositions. If these complexities can be cleared away or at least reduced, "The Fire Problem" then may be examined as a relatively simple

matter of physical conditions, primarily causative agencies, destructible values, fuels, topography, facilities, manpower, and "Management." As different men are certain to view "The Fire Problem" differently, and as point of view and perspective very definitely determine the "special arrangement and design of any panorama," whether it be of scenery, facts, or a fire research program, it is argued here that THESE THINGS deserve first attention. Settle these and the individual projects of a Fire Research Program will almost fall into place. Settle these and the money needed to finance a justifiable program of both fire control and fire research will become more self-evident to the public and to appropriating bodies.

IV. Evaluation of Priorities

Undoubtedly of first priority in the program of research needed, both because of immediate urgency and because of the long time that will be needed to solve it, is the Economics of Fire Control. This is omitted entirely from the present "set-up" or "breakdown" of fire research into fields of Behavior, Control, Effects, and General. The total economics of the problem include much more than just effects and until both effects and costs are brought into purposeful juxtaposition, and examined as the two basic phases of the whole problem, all other projects or phases are purely expedients, stop-gaps.

Whether or not the Economics of Fire Control should at this time be intentionally interwoven with the economics of protection from insects and disease seems questionable. Eventually, the economics of all forms of forest protection undoubtedly will stem from the master economics of wild land or forest management. Forest protection economics will then

coordinate and integrate the three recognized phases of protection research: Entomology, pathology, and pyrology. At present, however, it is probably best not to attempt to go that far. If the physical and social damages and benefits of fire can first be deliberately compared with the costs required for what now merely seems to be "adequate" protection from fire, progress will have been made. The great and the urgent need is for thought and clear expression on this basic phase previously so neglected that it has not even been named in the past as one field for research effort.

Second, in obviously logical order, is the distinctive field of fire prevention, for a fire prevented is a fire doing no damage and costing nothing for its control. In the particular region under analysis, however, prevention probably does not rank second in urgency. The percentage of preventable fires in Regions I, II, III, and IV is probably lower than that for any other area of similar size in the country. Quick and inexpensive control of the unpreventable lightning fires undoubtedly should be given priority over prevention research in this region. In the meantime advantage can be taken of prevention practices evolved by prevention research more efficiently concentrated in other parts of the country. No research in prevention is recommended for the area under study, and it is therefore barely mentioned in the project outline which follows.

Of high priority both on account of potential productiveness and because of outstanding progress already made is continued research in fire control. As is evident from the outline which follows the term, "control" is used here to include much more than mere suppression. The objective of adequate protection requires both adequate permanent facilities

and adequate and properly trained manpower available to use those facilities when, and only when, needed. This is much more extensive than mere suppression strategy, tactics, and tools.

As used here the term "control" also excludes certain features of fire suppression that have been, in the past, commonly confused with permanent facilities and manpower. These excluded features are phases of great importance but it is believed that they are so distinctively matters of management of men, or management policies, that the fire problem can be visualized more clearly and attacked much more effectively if they are classified separately.

This last field has been tentatively designated as "Management Policies." Possibly it should be merely "Management." As the outline shows, it includes many significant features nearly all of which are matters of action either BEFORE or AFTER fact finding research has fulfilled its functions. This phase of the fire problem is therefore believed to be almost entirely a field for administration, not research. As this idea is somewhat "radical" and may not be as sound as the writer now believes, it warrants some discussion here, even under the major caption of "Priorities."

Just one phase will be used as an illustration of a condition which may be a matter for Management (with a capital M) to decide, rather than depending upon research results. This is the choice between using many fire control positions as sources of employment, and livelihood, for local residents, or filling these positions with men from other parts of the country, including forestry students. This choice includes fire-fighting labor recruited locally, and perhaps trained into organized suppression squads vs. "pick-up," itinerant labor.

Such problems and many others, including expenditures for prevention vs. control, speed vs. strength of attack, full-time vs. per diem guards, single-purpose lookouts vs. lookout-smokechasers, and the executive ability or generalship of fire suppression "overhead," are here catalogued as problems for "Management," not Fire Research. They are vitally important problems, however, and cannot be overlooked in any thorough analysis of the fire problem on Federal, state, or private forest land.

It is believed that progress in these fields has lagged behind progress in the acquisition of knowledge concerning the physical facts of fire control. It does not follow, however, that Research should therefore enter this field. It might be more logical to contend that Administrative Management should concentrate its efforts within its own not-yet-thoroughly-cultivated fields rather than dissipate either funds or ability by spreading out into fields in which physical scientists are or can be made available.

V. Project Program

A. Economics

I. Determination of "Adequate Protection"

a. Physical Effects of Fire on:

(1) Commercial timber productivity

(2) Livestock forage

(3) Water control (including downstream engineering values)

(4) Recreation and wild life

(5) Other (meteorological, for instance)

b. Economic Effects of Fire and Fire Control Employment on Community, State, and National Welfare and Security

c. Definition of "Adequate Protection" for Specific Areas and Classes of Areas.

II. Financial Policy Essential to Adequate Protection

a. Specification of the present and near future maximum expenditures economically justifiable under A-I-c.

b. Distribution of actual (available) allotments

(1) By regions

(2) By forests and ranger districts

c. Cost accounting methods to determine true and actual fire control costs.

d. Financing for socio-economic and interdivisional benefits not essential to fire control for contributory to A-I-b.

B. Prevention

I. Man-Caused Fires

II. Lightning Fires

C. Control

I. Permanent Facilities to Meet:

a. Future occurrence rate

b. Fuel types

(1) Rate of spread

(a) Fundamentals of combustion

(b) Net effects of fuel character, condition, volume, and arrangement

(2) Resistance to control

c. Detection

d. Communication

e. Travel and transportation

f. Suppression equipment and subsistence

II. Manpower to Use Above Facilities

a. Qualifications

(1) Lookout, (2) smokechaser, (3) dispatcher, (4) fire boss, (5) fire assistant, (6) fire chief

b. Training

(1) to (6) as above

c. Quantity of men and duration of employment

(1) For detection

(According to incidence, visibility, and rate of spread)

(2) For suppression

(According to incidence and rate of spread in each resistance to control type)

(3) For socio-economic reasons (A-II-d)

D. Management Policies

I. Prevention vs. control

II. Speed vs. strength of attack

a. By fuel types

b. By class of day

III. Full time vs. per diem guards

IV. Lookouts vs. lookout-smokechasers

V. Intentional use of local labor for fire control positions as a contribution of work (and subsistence) to the local community

VI. Strategy of attack

a. On large individual fires

b. On a large number of large fires

VII. Tactics

a. Crew organizations

VI. Probable Cost

To commence work on the most urgent and to continue the currently productive projects included in the preceding list, the following personnel are recommended:

Economics: One man of associate or economist grade at each of the four experiment stations now working in this area. It is decidedly preferable that these men be basically trained in economics so that they can soundly apply established economic principles and methods to the special forestry conditions found, rather than to expect foresters to fit their specialties into an unfamiliar science broader than forestry. The work of these four men should be integrated with special care to insure coverage of all phases of the problem, one man, with special aptitudes or training, perhaps covering some one phase in several or all four regions, while another gives major attention to another phase. This is an attack on part A of the over-all objective of "adequate protection at least possible cost."

Prevention: No research.

Control: One assistant or associate grade forester assigned to fire control planning research at each experiment station until uniform principles and major differences can be found, tested, and accepted.

One associate grade forester assigned to fire danger measurement and fire behavior studies for Regions I and IV and another assigned to these same problems of Regions II and III. The former to be stationed at the Intermountain Station but coordinating his work with that already under way at the Northern Rocky Mountain Station.

This is an attack on part B of the over-all objective.

These two attacks, with 10 additional men, on the specification of "adequate protection," and the specification of how that can or might be attained, are all the additional or extended fire research recommended within this area of four national forest regions at present. In each case, and in the case of current studies of fire danger measurement and fire behavior at the Northern Rocky Mountain Experiment Station, adequate equipment and field and office assistance must be furnished.

For these purposes the sum of $75,000 would be required annually for at least 10 years. By contrast it is desirable to remember that in the northern Rocky Mountain area alone the annual cost plus loss due to fire on national forests alone now averages about $1,300,000 annually. A research investment of a little more than half of this when applied to four regions and to the costs and losses of three to five federal agencies, eight states, and countless private owners, over a 10-year period, is certainly not at all unreasonable.